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Standards and Calibration Laboratory

Environmental Controls

Prepared by:

Allen L. Gauler *01/12/99*

Date

Reviewed by:

Jerry T. Van Aken *01/12/99*

Date

Approved by:

Allen L. Gauler *01/12/99*

Date

ENVIRONMENTAL CONTROL PROCEDURE

1.0 PURPOSE

This procedure describes the controls on the physical environment in which calibrations are performed. Unless otherwise noted, these controls meet the requirements of the following documents:

- NCSL Recommended Practice RP-7, *Laboratory Design*.
- United States Department of Energy Primary Standards Laboratory Memorandum PSLM-3B, *Laboratory Environments*.

2.0 LABORATORY AREAS

The Standards and Calibration Laboratory (S&CL) maintains five separate laboratory areas, each with its own control requirements:

- The *Main Electrical Laboratory* (Room 6), in which most electrical calibrations are performed.
- The *Main Physical Laboratory* (Rooms 10 and 11), in which most physical calibrations are performed.
- The *Main Dimensional Laboratory* (Rooms 21 and 22), in which most dimensional and force calibrations are performed.
- The *Dimensional Modulab* (Room 23H), where high-accuracy dimensional calibrations are performed.
- The *Laboratory Annex* (Room 23P), where certain infrequently encountered calibrations are performed.

3.0 LABORATORY DESIGN

3.1 Main Laboratories

Exterior walls in the Main Laboratories are made of insulated concrete. Both the Main Electrical Laboratory and the Main Physical Laboratory have glass blocks windows in a portion of their exterior walls. In order to block solar radiation, all glass block windows have been covered on the outside with metal panels set about four inches out from the window. Windows in the Main Physical Laboratory have also been insulated on the inside. Interior walls are made of cinder block and are not insulated. Air is ducted to various points in the ceiling and enters the room through diffusers set in the ductwork. Return air is drawn in through vents near the floor.

3.2 Dimensional Modulab

The walls of the Dimensional Modulab are made of two metal sheets with a hollow space between them. The room is entirely contained inside the building, and is set apart from its interior or exterior walls. Air is ducted to a plenum in the ceiling of the room and is forced into the room through perforations in the ceiling. Return air is drawn in at floor level through openings in the baseboard and travels back to the HVAC unit through the hollow walls of the room.

3.3 Laboratory Annex

The walls and ceiling of the Laboratory Annex are made of metal studs and drywall. All walls are interior to the building. Air is ducted to various points in the ceiling and enters the room through diffusers set in the ductwork. Return air is drawn in through vents near the floor.

4.0 CONTROLLED OR MONITORED QUANTITIES

The following quantities are controlled or monitored in laboratory areas:

- Heating, Ventilation, and Air Conditioning
    - Temperature
    - Humidity
    - Particle Filtration
    - Positive Air Pressure
- Security
- Fire Protection
- Cleanliness
- Vibration
- Electrical Power
- Grounding
- Lighting

5.0 HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) SYSTEM

5.1 System Description

5.1.1 Main Laboratories

The Main Laboratories are served by one HVAC system, HVA-004. Ninety percent of the air for this system is recirculated from the laboratories and ten percent is drawn in from outside the building. An air conditioner cools the air, after which it is filtered and routed to each laboratory space. Before entering the laboratory, the air is steam heated to the desired temperature. Temperature in each lab area is individually controllable using pneumatic thermostats.

5.1.2 Dimensional Modulab

The Dimensional Modulab has its own dedicated HVAC system. Ninety percent of the air for this system is recirculated from the Modulab and ten percent is drawn in from outside the Modulab (but

inside the building). An air conditioner cools the air, after which it is filtered and electrically heated to the desired temperature. Temperature in the Modulab is controlled by a proportional control circuit that receives feedback from a thermistor mounted at ceiling level in the room.

5.1.3 Laboratory Annex

The Laboratory Annex has its own dedicated HVAC system, ACR-001. Ninety percent of the air for this system is recirculated from the Annex and ten percent is drawn in from outside the building. In this system, the air conditioner itself is cycled on and off to achieve the desired temperature. Temperature in the Annex is controlled by a bimetallic thermostat.

5.2 Temperature

5.2.1 Nominal Values and Tolerance Limits

Temperature at bench top level is controlled to the following nominal values and tolerance limits:

Laboratory	Nominal	Tolerance
Main Electrical Laboratory	23 deg C	+/- 1.0 deg C
Main Physical Laboratory	23 deg C[1]	+/- 1.0 deg C
Main Dimensional Laboratory	20 deg C[2]	+/- 1.0 deg C[3]
Dimensional Modulab	20 deg C	+/- 0.25 deg C
Laboratory Annex	23 deg C	+/- 2.0 deg C

5.2.2 Monitoring and Recording

Air temperature is continuously monitored and recorded in each laboratory area. The Unit Leader of each section is responsible for assuring that the monitoring devices in their laboratory areas are calibrated and operating properly. Air temperature recordings are considered to be controlled records and are maintained in accordance with SCL-PD-0007, Records.

5.2.3 Temperature Deviation Protocol

When the air temperature in a laboratory is seen to deviate from the limits specified above, the Unit leader will assure that the following protocol is followed.

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[1] PSLM-3B calls for a nominal temperature of 20 deg C for mass calibration. Because it is not practical to have two set points within the Main Physical Laboratory, all areas are set to 23 deg C. The different setpoint does not affect measurement accuracy because temperature is corrected for when doing mass calibrations.

[2] PSLM-3B calls for a nominal temperature of 23 deg C for force calibration. Because it is not practical to have two setpoints within the Main Dimensional Laboratory, all areas are set to 20 deg C. The different setpoint does not affect measurement accuracy because temperature is corrected for when doing force calibrations.

[3] PSLM-3B calls for general dimensional calibration laboratories to be controlled to +/- 0.5 deg C, which cannot be achieved with the present control system in the Main Dimensional Laboratory. Therefore, direct and comparison measurements to less than 10 ppm of length for steel or 30 ppm of length for aluminum must be performed in the Dimensional Modulab. These limits are twice those specified for general dimensional measurement in PSLM-3B.

- Except as specified below, no calibrations will be performed in the Main Physical Laboratory, Main Electrical Laboratory, or Laboratory Annex for a settling period equal to the lesser of the following: four hours or the amount of time the temperature was out of tolerance.

- Except as specified below, no calibrations will be performed in the Main Dimensional Laboratory or the Dimensional Modulab for a settling period equal to the lesser of the following: seven days or the amount of time the temperature was out of tolerance.

- If calibrations must be performed before the settling period has expired, a judgement must be made that the calibration can be performed correctly under these conditions (in some cases, it may be necessary to measure the temperature of the standard and the unit under test and apply corrections). The air temperature at the time of test and the actions taken to permit a calibration to be performed under these conditions must be documented on the Non Standard Temperature Documentation Form at the end of this procedure and included in the report package for the unit under test.

- For any calibrations that were inadvertently performed during the time the temperature was out of tolerance, a judgement must be made as to whether the calibration is valid or must be repeated. If it is determined that the calibration is valid, the approximate air temperature at the time of test and the actions taken to make the calibration valid (for example, calculations to correct for a non-standard temperature) must be documented on the Non Standard Temperature Documentation Form at the end of this procedure and included in the report package for the unit under test.

5.3 Humidity

5.3.1 Nominal Values and Tolerance Limits

Due to limitations in the existing HVAC system, relative humidity in laboratory areas is not controlled. However, the following nominal values and tolerance limits serve as action points:

Laboratory	Nominal	Tolerance
Main Electrical Laboratory	40%	+10%, -20%
Main Physical Laboratory	None [4]	None
Main Dimensional Laboratory	None	None
Dimensional Modulab None	None	
Laboratory Annex	None	None

[4] PSLM-3B specifies that humidity be controlled to 35%+/-3% in mass, force, and dimensional laboratories, and to 40%+/-5% in the physical laboratory. When humidity is higher than these limits, performance degradation due to rust or corrosion may result. When humidity is lower than these limits, electrostatic effects may result. Because neither result has been observed over a period of many years, it is believed that humidity control is unnecessary in the prevailing local climatic conditions and with the present HVAC system.

5.3.2 Monitoring and Recording

Humidity is required to be monitored and recorded only in the Main Electrical Laboratory. The Unit Leader of the electrical section is responsible for assuring that the monitoring devices in the Main Electrical Laboratory are calibrated and operating properly. Humidity recordings from the Main Electrical Laboratory are considered to be controlled records and are maintained in accordance with SCL-PD-0007, Records.

5.3.3 Humidity Deviation Protocol

When the humidity in the Main Electrical Laboratory is seen to deviate from the limits specified above, the following protocol must be followed.

- If calibrations must be performed during this period, the technician performing the calibration must be alert to the potential for a degradation of accuracy. Humidity higher than 50% may cause electrical leakage paths, and humidity lower than 20% may result in electrostatic effects.

5.4 Particle Filtration

The HVAC system provides particle filtration to the following levels:

- Main Laboratories: Normal Room Filtration.
- Dimensional Modulab: HEPA Filtration.
- Laboratory Annex: Normal Room Filtration.

5.5 Positive Air Pressure

The HVAC system in all laboratory areas is set to provide a positive air pressure of 0.05 to 0.1 inch of water.

6.0 SECURITY

The S&CL is located inside a secured building, where entry and exit is past a manned guard station. To further reduce security risk, all laboratory areas are locked after normal duty hours.

7.0 FIRE PROTECTION

All laboratory areas are equipped with automatic water fire suppression systems. In addition, Halon portable fire extinguishers are located in each laboratory area.

8.0 CLEANLINESS

8.1 Food and Drink

Food and drink are allowed in laboratory areas but are restricted to designated eating and drinking areas where calibration work is not performed.

8.2 Cleaning Area

A cleaning area is provided outside the Main Dimensional Laboratory. The area is locked and restricted to S&CL personnel.

8.3 Dust Removing Pad

The Dimensional Modulab is equipped with a Dust Removing Pad to remove dust from employees' shoes when they enter the room.

8.4 External Storage Areas for Chemicals

Chemicals are stored in cabinets located outside the laboratory areas. Small quantities may be kept in laboratory areas for easy access.

9.0 VIBRATION

Vibration is controlled on individual measurement systems when experience indicates that it may affect measurement accuracy. Three methods are used, in order of increasing effectiveness:

- Equipment may be placed on heavy platforms such as surface plates.
- The platforms may be isolated from the floor using vibration-dampening materials.
- The platforms may be supported using air suspension systems.

10.0 ELECTRICAL POWER

10.1 Clean Power

All power for S&CL operations is routed through conditioning equipment that removes major power spikes.

10.2 Hospital Grade Power

Hospital Grade power outlets are provided in some locations within the Main Electrical Laboratory and the office area. These outlets include a measurement ground connection in addition to the normal building ground connection, and are used for instruments such as the S&CL server that are extremely sensitive to transient voltages.

10.3 Uninterruptable Power Supplies

In selected cases where the interruption of power could cause damage or loss of data, instruments are protected by means of individual uninterruptable power supplies.

11.0 GROUNDING

The Main Electrical Laboratory is equipped with a measurement ground, consisting of a grounding rod surrounded by a conductive chemical solution. The ground can be accessed throughout the laboratory by means of a shielded cable.

12.0 LIGHTING

Light fixtures in all laboratory areas are designed to deliver 100 lumens/sq ft at benchtop level. All occupied areas are equipped with emergency lighting.

13.0 ON-SITE CALIBRATIONS

When possible, equipment is calibrated in the S&CL laboratory areas described above. In some cases, however, transporting equipment to these areas is not practical due to factors such as its size, potential contamination, or distance from the S&CL. In these cases, the technician performing the calibration must determine whether the environmental conditions at the site are sufficiently controlled to permit a valid calibration. When the environmental conditions do not permit a normal calibration, it may be necessary to limit the calibration.

Because temperature is generally the most critical of the environmental parameters, the air temperature at the site must be measured. If it is not within the limits specified in this document, a judgement must be made that the calibration can be performed correctly under these conditions. The temperature at the time of test and the actions taken to permit a calibration to be performed under these conditions must be documented on the Non Standard Temperature Documentation Form below and included in the report package for the unit under test.

Non Standard Temperature Documentation Form

Los Alamos National Laboratory
Standards and Calibration Laboratory

Instructions: Fill out this form and include it in the report package for the unit under test when the temperature at the time of test is not within the following limits:

Calibration Type	*Nominal*	*Tolerance*
Electrical	*23 deg C*	*+/- 1.0 deg C*
Physical	*23 deg C*	*+/- 1.0 deg C*
Dimensional	*20 deg C*	*+/- 1.0 deg C*
Precision Dimensional[5]	*20 deg C*	*+/- 0.25 deg C*

File Number of Unit Under Test: _____

File Number of Temperature Readout: _____

Observed Air Temperature: _____

Actions Taken to Correct for Non-Standard Temperature:

0 Not Required

0 Required

Explanation of Required Actions (If Any):

_____

_____

_____

_____

By:_____ Date:_____

[5] Precision dimensional measurements are defined as those involving direct or comparison measurements to less than 10 ppm of length for steel or 30 ppm of length for aluminum.